Motor precision is crucial for aircraft electronic expansion valves

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Stepper motors play an integral role in ensuring the comfort of airplane passengers. Achieving precise, repeatable control of the crucial electronic expansion valves within an aircraft's Environmental Control System (ECS), these motors must also ensure high durability. With customization for design integration also a common requirement, this makes motor specification a crucial stage in the development of an aircraft's Environmental Control System.

Within an aircraft cabin, an ECS is essential, both for safety, as well as the comfort of passengers and aircrew. This technology regulates the pressure and temperature within the cabin, and integral to the system are the valves that control airflow. Particularly for the management of air conditioning and refrigeration, the electronic expansion valve (EEV) is key. With the role of precisely controlling refrigerant flow, these valves enable efficient temperature regulation onboard.

An electric motor actuates the electronic expansion valve via signals received from the ECS controller, which monitors cabin temperature. The motor drives precise valve regulation to control refrigerant flow into an evaporator. While the evaporator is fed by air from outside the aircraft, which is heated by compression or through bleed air from the engine, the blend of refrigerant balances air temperature within the cabin.

The advantage of an electric motor and controls is variable modulation, and it's this flexibility that is crucial to fine-tune refrigerant flow and optimize passenger and crew comfort. The motor must be able to achieve the required level of precision, and stepper motors are the typical choice. This motor design opens or closes the

expansion valve in small, controlled steps; these increments are measured in fractions of a degree, dependent on the resolution of the motor, and this adjustment achieves precision in valve control.

Repeatable control

Crucially, the stepper motor also ensures repeatable control. Since it moves in discrete steps, with each step corresponding to a fixed angular movement, this enforces its precision. Enhancing control repeatability, a stepper motor also provides the higher torque required for the relatively low speed operation of the valve. This means that the stepper motor can generate sufficient holding torque to maintain its position without losing steps when under pressure of the refrigerant.

Although an aircraft's ECS should include redundancy, protecting against motor failure is vital to minimize the cost and time of maintenance. The design of the stepper motor is inherently durable as it doesn't rely on mechanical brushes to achieve commutation, and neither does it need a feedback device or a complex closed-loop controller. This simplicity also helps secure a lower cost in procurement. However, when selecting a stepper motor, it's essential to ensure it can withstand temperature extremes, including temperatures up to 130 degrees Celsius faced by the evaporator, as well as the low temperatures of the refrigerant.

Low weight and size are also important to improve an aircraft's fuel efficiency and cargo-carrying capability. Stepper motors achieve high torque density for their low-speed operation requirements, and as they don't require complex external electronics or feedback, this advantage reduces the total weight and size of the package.

In addition, can stack stepper motors can also be advantageous for some EEV applications. Can stack motion technology focuses on simplicity. This permanent magnet stepper motor uses the simplest of techniques and designs to create an effective solution where reasonable accuracy and moderate torque are required.

Customization and design integration

As an alternative to stepper motors, brushless DC (BLDC) motors could be used to enhance the speed and efficiency of control, while minimizing form factor and weight. While this design adds cost, alongside the need for external electronic controls, it could provide an advantage for aircraft that need more rapid changes in cabin temperature control. The more efficient operation of a BLDC motor can also add reliability and minimize the potential for overheating when under duress.

As part of motor specification, customization might also be required, particularly to enhance design integration. Features such as customized mounting plates and output pinions might be necessary, as well as modifications to the motor itself. Partnering with a micro motor manufacturer like Portescap that provides customizable, off the shelf designs, as well as fully tailored motion solutions, is beneficial. This approach not only minimizes the time and cost of internal development, but the experience in motor customization helps to ensure performance and reliability is maintained.

Image captions:

Image 1: An aircraft's Environmental Control System (ECS) typically relies on stepper motor technology.

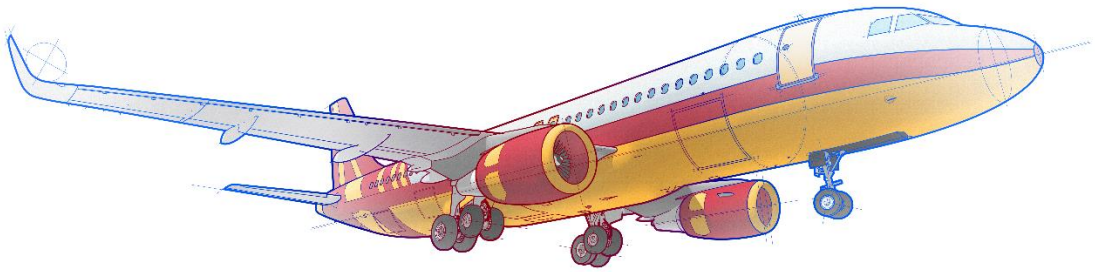

Image 2: An ECS relies on valve control to regulate pressure and temperature within the aircraft.

Image 3: Can stack technology achieves reasonable accuracy and moderate torque.

About Portescap

Portescap offers the broadest miniature and specialty motor products in the industry, encompassing coreless brush DC, brushless DC, stepper can stack, gearheads, digital linear actuators, and disc magnet technologies. Portescap products have been serving diverse motion control needs in wide spectrum of medical and industrial applications, lifescience, instrumentation, automation, aerospace and commercial applications, for more than 70 years.

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